THE HAWAIIAN PLANTERS' RECORD

Volume XXIV. APRIL, 1921 Number 4

A monthly paper devoted to the sugar interests of Hawaii and issued by the Experiment Station for circulation among the Plantations of the Hawaiian Sugar Planters' Association.

H. S. P. A. Committees.

The Secretary of the Association informs us that the following are the committees thus far appointed by the President, Mr. E. Faxon Bishop:

INDUSTRIAL SERVICE COMMITTEE:

C. R. Hemenway,
George F. Renton, Jr.
R. A. Cooke,
F. C. Atherton,
Wm. Searby.

LABOR COMMITTEE:

J. M. Dowsett,
E. D. Tenney,
E. F. Bishop,
A. W. T. Bottomley,
E. H. Wodehouse,
John Waterhouse.

EXPERIMENT STATION COMMITTEE:

A. Gartley,
C. R. Hemenway,
T. H. Petrie,
J. W. Waldron,
G. P. Wilcox,
J. N. S. Williams.

Cutting Back Versus Not Cutting Back.

Oahu Sugar Company Experiment No. 12 (1920 Crop).*

SUMMARY.

This experiment compares the practice of cutting back against not cutting back of D 1135 at an elevation of 550 to 600 feet. As originally laid out, this experiment involved both Lahaina and D 1135, but because of the ravages of Lahaina disease on the Lahaina, only the D 1135 area was harvested.

The results are decidedly against cutting back. This operation caused a decreased yield of 7.45 tons cane or 1.16 tons sugar. The following tabulation shows the actual yields obtained:

Plot	No. Plots	Treatment	Yields in Tons per Acre	
			Cane	Sugar
C	18	Cut back	89.61	12.28
X	18	Not cut back	97.06	13.44

The previous crop was harvested the first week in May, 1918, and from then until July 7, 1918, the field received no fertilizer, but sufficient water to keep it growing. Cutting back took place on the latter date, when the cane was from 12 to 18 inches high. All plots were given uniform fertilization, consisting of two applications of 400 pounds each of complete fertilizer and two doses of 262.5 pounds each of nitrogen mixture. In the first week of January, 1919, after tasseling was complete, a count was made of the tasseled and untasseled sticks in the middle row of each plot. In the case of D 1135 there were no tassels in either the cut-back or the not-cut-back portions, while in the case of Lahaina there were no tassels in the cut-back portion, but in the not-cut-back portion 16% of the stalks had tasseled.

Curve Showing The Yield In Sugar Per Acre For Each Plot, Cut Back & Not Cut Back.
Oahu Sugar Co. Exp. 12, 1920 Crop
Field 49. (New Land)

* Experiment planned by J. A. Verret.

The treatment seems to have made no difference in the quality of the juices, as is shown by the following tabulation:

Treatment	Brix	Pol.	Pur.	Q. R.
Cut back	22.66	18.73	82.66	7.30
Not cut back	22.36	18.78	83.99	7.22

DETAILS OF EXPERIMENT.

Object: To determine the value of cutting back versus not cutting back for fields at an elevation of 600 feet.

Location: Oahu Sugar Company, Field 49, Hoaeae Section, Section 2, Divisions 6 to 14, inclusive, of experimental area of this field.

Crop: Lahaina and D 1135 in plots and D 1135 in crop areas, first ratoons, long.

Layout: No. of plots, 36.

Size of plots, 1/20 acre each (39.6′x 55′), consisting of 10 single rows 5.5′ wide and 39.6′ long. Each plot one water-course in width. Each single row 1/200 acre. These areas include water-courses.

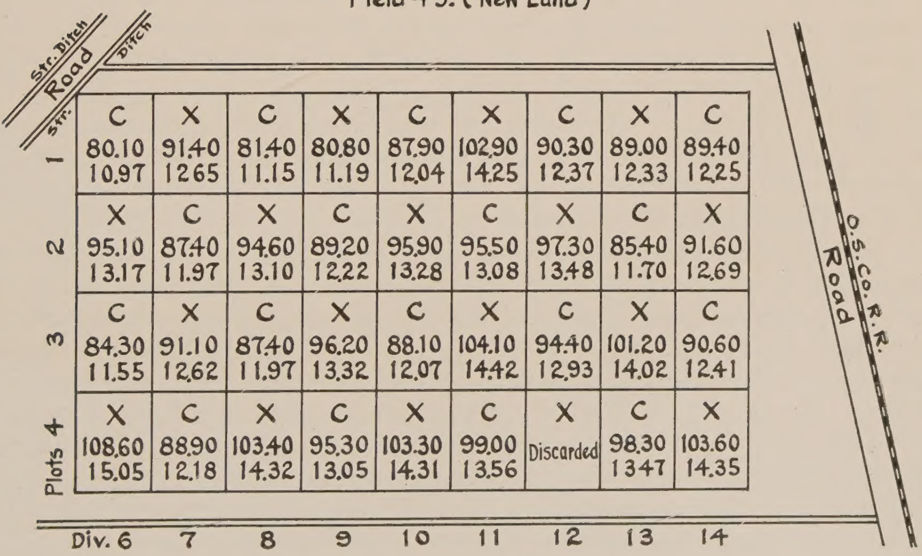
Plan: All C plots (which were EE, DD, or CC plots for the 1918 crop) are to be cut back, and all X plots are not to be cut back.

Fertilization uniform to all plots and crop cane as follows:

August, 1918—400 pounds per acre of C. F.

October-November, 1918—262.5 pounds per acre of N. M.

CUT BACK VS. NOT CUT BACK
Oahu Sugar Co. Exp. 12, 1920 Crop
Field 49. (New Land)



Summary of Results

Plots	No. of Plots	Treatment	Yields Per Acre			Gain or Loss Over Cut Back Plots.	
			Cane	Q.R.	Sugar	Cane	Sugar
C	18	Cut Back	89.61	7.30	12.28		
X	18	Not Cut Back	97.06	7.22	13.44	+ 7.45	+ 1.16

February-March, 1919—400 pounds per acre of C. F.
May-June, 1919—262.5 pounds per acre of N. M.

C. F. = complete fertilizer: 10% N. (7% sulfate, 3% nitrate), 8% P_2O_5, 1% K_2O.
N. M. = 18% N. mixture (½ nitrate, ½ sulfate).

PROGRESS OF WORK.

July 7, 1918—Cut back.
August 26, 1918—First fertilization.
November 4, 1918—Second fertilization.
January 3-5, 1919—Tassels counted.
February 21, 1919—Third fertilization.
June 6, 1919—Fourth fertilization.
August 9-13, 1920—Experiment harvested by Y. Kutsunai.
Juices sampled in carload lots at mill by R. Pahau.

R. S. T.

The Laborer's Teeth.

BAD TEETH CAUSE OF LESSENED PRODUCTION.

By Donald S. Bowman, *Industrial Service Bureau, H. S. P. A.*

In considering the general health and welfare of the plantation employees, the importance of good teeth has had but little consideration. We cannot overestimate the value of good teeth. We must consider that prophylaxis is far superior to any curative measures which may be resorted to when decay is shown. Carious teeth have much to do with ill health. "Such conditions as alveolar abscess, enlarged cervical glands which may eventually become tuberculous, inflammatory affections of the throat, eye troubles, pernicious anaemia, arthritic disease, and such conditions as are due to septic absorption, all may be caused by unhealthy teeth. There seems to be no limit to the conditions which may develop to affect the health of the individual who has decaying teeth."*

It is generally understood that bad teeth are the cause of imperfect mastication, which in turn causes indigestion, producing in many cases malnutrition with all its attending consequences, such as anaemia, general feebleness, lack of energy, drowsiness by day and sleeplessness at night, headaches, depression of spirits, and so on. Conditions of this kind do not make for strength on the part of the laborer. On the contrary, his health becomes more and more impaired as a result of them. In some cases the laborer is strong enough and has a reserve of energy which enables him to overcome the bad effects of decaying teeth. To the average laborer, bad teeth mean impaired health and loss of work, or a diminished output. In carrying on the Industrial Service work we should consider the value of healthy teeth irrespective of age. It is apparent that there are many laborers with teeth in such a condition as to have a disastrous influence on their general health, causing a lessened production of work.

In considering the question of teeth and the plantation worker, it would be well to carry on a test or survey in order to have specific data to show just how

* Extract from Journal of Industrial Hygiene.

badly dentists are needed for plantation work. There is no question but that a great deal of good could be accomplished, and a survey may prove that it would be good business for the plantations to undertake this work.

Many of the larger factories on the mainland employ physicians and dentists who examine all persons who apply for work. If an applicant is accepted but has bad teeth he or she has immediate attention, and the teeth are put in such a condition as not to interfere with general health or production. Should the worker desire any bridge, crown, or gold work, it is at his or her expense. Once each month the teeth of all employees are examined and such dental work done as is necessary.

A system similar to this would no doubt operate well on the plantations, and a survey will no doubt prove that a dentist would be able to serve more than one plantation.

The amount of money to be expended by the plantations for the general welfare of the workers is necessarily limited. Therefore, it is well to consider that which will do the most good. It appears from the data at hand, without the benefit of a local survey, that a great deal of good could be accomplished by employing dentists for plantation work, and that the increase in the production of the workers who are improved in health and morale through dental treatment would prove it to be a good business proposition for the plantations.

With Reference to the Changing of Old Lap-Seam Boilers to a Butt-Seam Construction.*

Not long after the steam boiler came into general use in America, considerable discussion was aroused with respect to the question of limiting the life of a boiler. Numerous instances of serious accident, which it seemed impossible to account for, had impressed many with the idea that a boiler, like any other piece of apparatus, was subject to deterioration from constant use and that therefore it would be best to take a boiler out of service after a certain period. In fact, a number of concerns followed this practice. The majority of boiler users and engineers, however, felt then as they do now that rigid inspection would safeguard their boiler plants and would furthermore be of greater service in the interest of economy, for it was admitted that many boilers had served for twice the life that, by some, had been allowed for safety.

The plan of relying on inspection for a forewarning was adopted and served well, but there were a number of unaccountable explosions in boilers of relatively short life. At the time, the majority of boilers in use were constructed with a longitudinal lap joint. A series of investigations was conducted to study the stress conditions in this type of joint, and it was found that the construction, both from its fundamental shape and the conditions of manufacture, presented a most dangerous condition.

In The Locomotive for April, 1905, there appeared an account of the disastrous boiler explosion at Brockton, Mass., on March 20, 1905, and also an article

* The Locomotive, January, 1921, pp. 141-146.

on the "Lap-joint Crack" to which type of defect the explosion was said to be due. For the sake of clearness we shall present here some of the more important points which were brought out in the last-named article.

When a boiler plate is rolled to a cylindrical form, the edges of the plate, in passing through the rolls, are not gripped as effectively as is the middle of the plate, so that the ends are left somewhat flat. The condition produced is illustrated in Fig. 1. This necessitates the plates being forced together at the edges

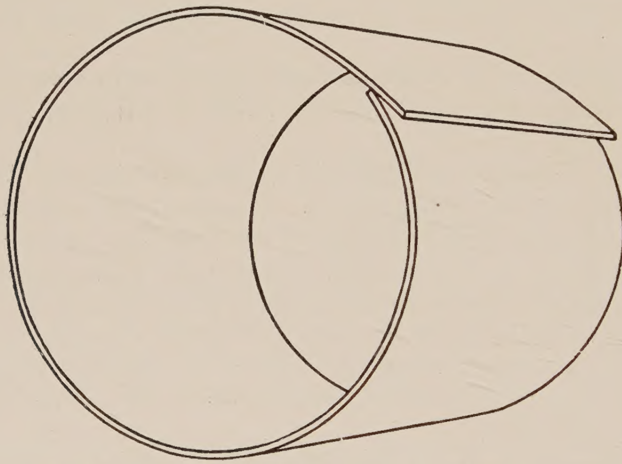


Fig. 1.

and this produces an added stress that persists unless relieved by annealing. In addition to this the plates, if bent after punching, will bend along a line of rivet holes as shown in Fig. 2 in somewhat exaggerated form.

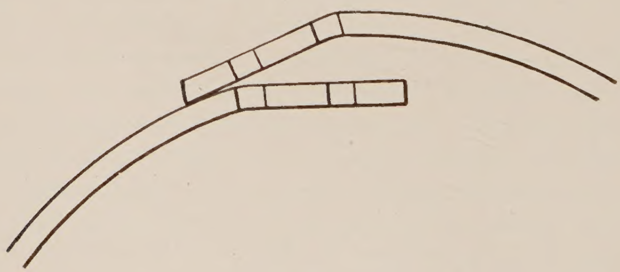


Fig. 2.

The elementary lap joint is illustrated in Fig. 3. If tension is applied as indicated in Fig. 4, the plates, in an attempt to align themselves with the load, will bend along a line running under the outer edge of the rivet heads.

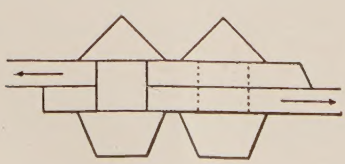


Fig. 3.

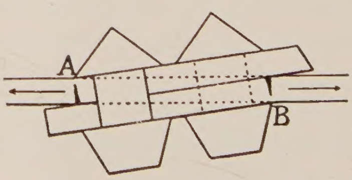


Fig. 4.

The combined effect of all these conditions, together with the constant bending of these joints by changes of pressure when in use, is to impose excessive stresses in the surface of the boiler plate along the line just mentioned. This has produced, in many boilers, a crack which starts always from the inside or covered surface of the inside or the outside plate of the joint as indicated at A and B in Fig. 4. This crack may eventually work its way through the plate until it shows itself by leakage. But in many cases it may develop for some distance along the joint and yet remain absolutely invisible. Eventually the weakness may develop to the point of complete failure and a disastrous explosion.

Inspection is generally accepted as being safe for the determination of the fitness of a boiler for use. The lap-seam crack, however, is invisible to all methods of inspection, except cutting out the rivets and separating the plates or the method described in The Locomotive for October, 1914. Recognizing the insidious danger presented in the lap joint for longitudinal seams in boilers, the Boiler Code Committee of the American Society of Mechanical Engineers formulated the following regulation: (par 380, A.S.M.E. Boiler Code, Edition 1918.)

"The age limit of a horizontal return-tubular boiler having a longitudinal lap joint and carrying over 50 *lbs. pressure shall be* 20 *years, except that no lap-joint boiler shall be discontinued from service solely on account of age until* 5 *years after these rules become effective."*

Some boiler owners may be of the opinion that the longitudinal lap seams of boilers of this type can be changed to butt-strap construction and the boilers kept in service after the time limit. This change of design and construction is not approved, however, by those thoroughly familiar with steam boilers, for, although butt straps and more rivets may be added, the material along the line of the joint, which was abused and tortured by the forming of the lap joint and fatigued by the years of service which subjected it to the expansion and contraction brought about by the many changes of temperature and pressure, would be further abused on the portion of the original construction left after cutting off one side of the lap joint and forcing the edges of the plate into line to form a butt joint.

Assuming that a double-riveted lap joint has been changed to a triple-riveted butt construction, the joint, after placing the butt straps and riveting, would appear as shown in Fig. 5 on page 135 with the rivet holes of the original lap joint at B and the new holes at C. If a defect existed in the plate as shown at A, the joint would be very faulty. Assuming the original joint as having the rivet holes spaced 3¼ inches and the additional holes spaced 6½ inches, if the plate material were defective or contained a lap crack as shown, the failure of the joint would require only the shearing of the rivets in long pitch, or 6½ inches, and the failure of the defective plate.

It might be argued that the exposure of the inside of the lap seam, when the change to a butt seam is made, would reveal the presence of a lap-seam crack. A crack of this nature is, however, often present in a boiler of this construction after years of service although it may not be visible to the naked eye. But, even though no crack exists, it must be remembered that boiler plate, like any other material, becomes fatigued after long years of service, and for this reason, after it has been under stress for many years, it should not be subjected to a change of shape and torture of the material in an endeavor to keep the boiler in service, especially when there is evidence that the altered structure is defective.

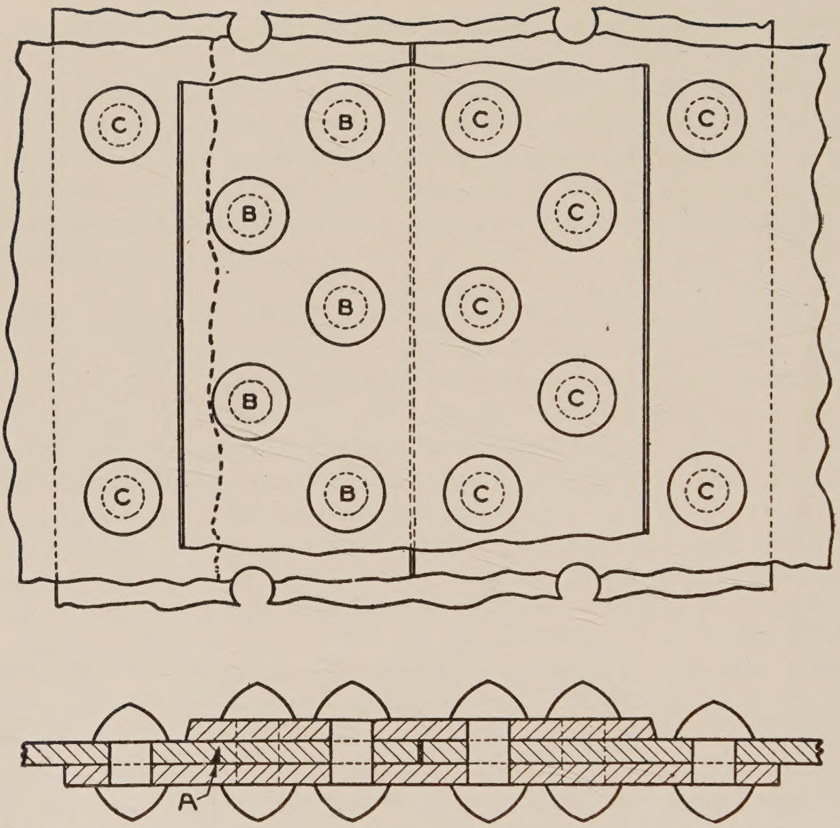


Fig. 5.

The age limit of twenty years is none too exacting, as will be evidenced by an explosion, resulting from a lap-seam crack, of a boiler at the Tallahoma Lumber Co., at Mossville, Miss., on October 21st, 1920. This boiler was less than five years old. The explosion completely wrecked the plant, killed three men and injured four others. There was no negligence on the part of the operators, and there was ample proof that the accident did not result from low water or overheating. On the other hand, the lap-seam cracks could be clearly seen in the boiler plates after the disaster.

Regulations such as we have quoted are not intended to be arbitrary. Railroad companies determine the safe load capacity for each of their freight cars, and if they discover an overloaded car they refuse to transport it. This is done not only to avoid the possibility of straining or breaking the overloaded car, but also to prevent a possible wreck which might result in loss of life, property damage, and delay. In a like manner the Boiler Code Committee requests that steam boilers and pressure vessels be designed and constructd for a safe working pressure and that they be not subjected to overloads. The rule quoted above is sane and economic because it is intended for the protection of life, limb, and property. So also should be regarded the action of the boiler inspector in condemning any construction regarded as unsafe.

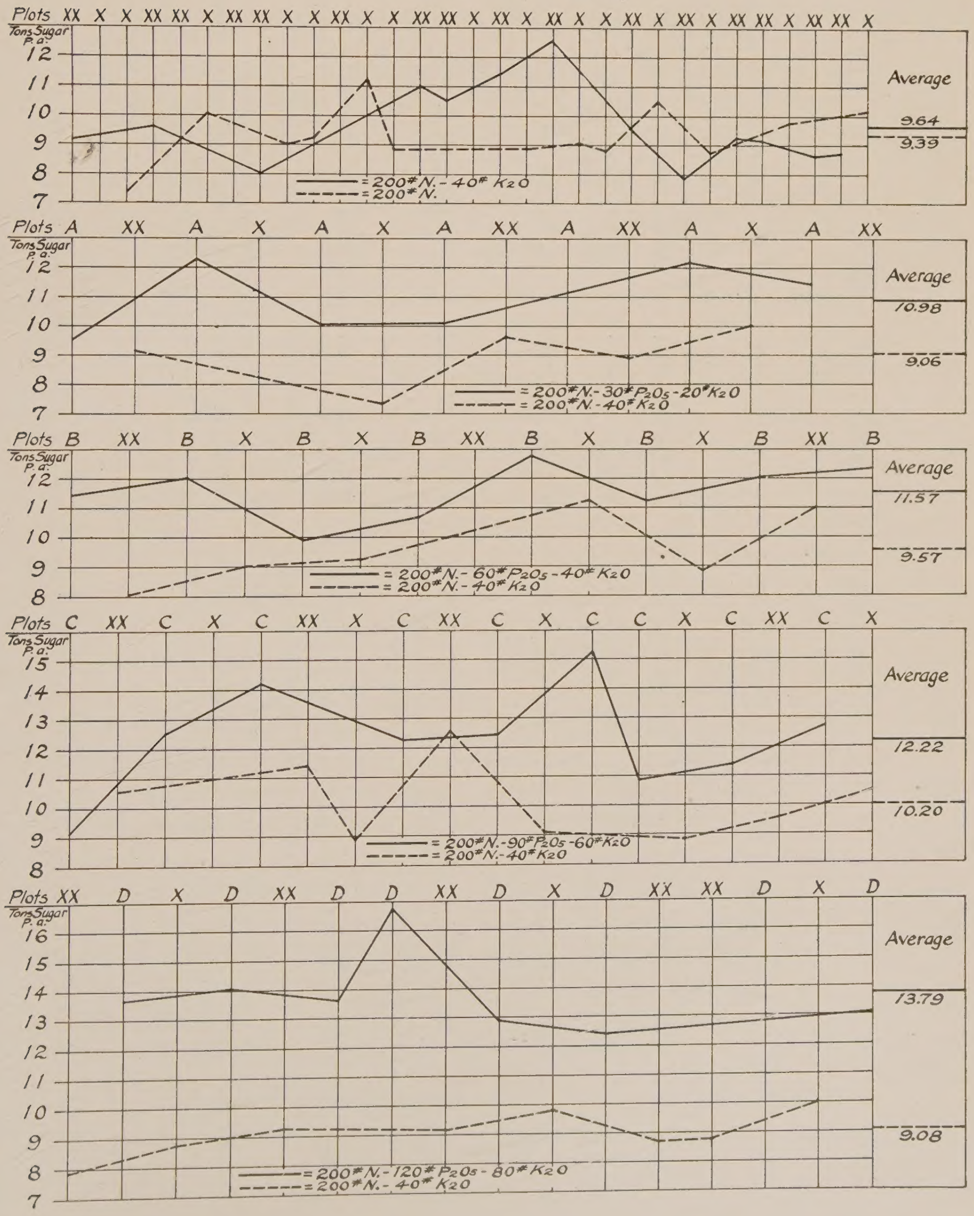
[W. E. S.]

Amount of Fertilizer to Apply.

Oahu Sugar Co., Exp. No. 4, 1920 Crop.

In this experiment a comparison was made between complete fertilizer in varying amounts with nitrogen alone, and with potash.

Curves Showing Yields Of Individual Plots For
Varying Amounts Of Phosphoric Acid & Of Potash.
D1135 Plots Only.
Oahu Sugar Co. Exp. 4, 1920 Crop
Field 45 (Virgin Land)



FERTILIZATION—POUNDS PER ACRE.

Plots	No. of Plots	Aug. 30, 1918	Nov. 8, 1918	Feb. 19, 1919	May 27, 1919	Total Pounds		
						Nitrogen	P_2O_5	K_2O
X	15	278 lbs. Nit. Mix.	278 lbs. Nit. Mix.	278 lbs. Nit. Mix.	278 lbs. Nit. Mix.	200	0	0
XX	16	278 lbs. Nit. Mix. 41 lbs. Sul. Pot.	278 lbs. Nit. Mix. 69 lbs. Mol. Ash	278 lbs. Nit. Mix. 0	278 lbs. Nit. Mix. 0	200	0	40
A	7	278 lbs. Nit. Mix. 159 lbs. Acid Phos. 41 lbs. Sul. Pot.	278 lbs. Nit. Mix. 0 0	278 lbs. Nit. Mix. 0 0	278 lbs. Nit. Mix. 0 0	200	30	20
B	8	278 lbs. Nit. Mix. 159 lbs. Acid Phos. 41 lbs. Sul. Pot.	278 lbs. Nit. Mix. 160 lbs. Acid Phos. 69 lbs. Mol. Ash	278 lbs. Nit. Mix. 0 0	278 lbs. Nit. Mix. 0 0	200	60	40
C	9	278 lbs. Nit. Mix. 159 lbs. Acid Phos. 41 lbs. Sul. Pot.	278 lbs. Nit. Mix. 160 lbs. Acid Phos. 69 lbs. Mol. Ash	278 lbs. Nit. Mix. 160 lbs. Acid Phos. 69 lbs. Mol. Ash	278 lbs. Nit. Mix. 0 0	200	90	60
D	8	278 lbs. Nit. Mix. 159 lbs. Acid Phos. 41 lbs. Sul. Pot.	278 lbs. Nit. Mix. 160 lbs. Acid Phos. 69 lbs. Mol. Ash	278 lbs. Nit. Mix. 160 lbs. Acid Phos. 66 lbs. Mol. Ash	278 lbs. Nit. Mix. 160 lbs. Acid Phos. 66 lbs. Mol. Ash	200	120	80

The cane was Lahaina and D 1135, first ratoon, long, and was 28 months old when harvested. The field is at an elevation of approximately 550 feet and is irrigated with mountain water. From January, 1920, to harvest, in November, this field was not irrigated. During this time the rainfall amounted to 23 inches, most of it in January and March.

The schedule of fertilization is shown on page 137.

The results obtained from this crop, as well as those from the plant crop, two years ago, are given in the following tables:

1918 CROP, LAHAINA.

Plots	Fertilizer, Pounds per Acre			Yield per Acre			Gain over adjoining X Plots	
	Nitrogen	P_2O_5	K_2O	Cane	Q. R.	Sugar	Cane	Sugar
A	200	30	20	62.40	7.62	8.19	+ 5.33	+ 0.67
X	200	0	0	57.07	7.59	7.52		
B	200	60	40	66.28	7.71	8.59	+ 10.87	+ 1.33
X	200	0	0	55.41	7.63	7.26		
C	200	90	60	67.44	8.11	8.32	+ 10.80	+ 1.24
X	200	0	0	56.64	8.00	7.08		
D	200	120	80	69.67	8.66	8.04	+ 13.58	+ 1.36
X	200	0	0	55.09	8.75	6.68		

1920 CROP, LAHAINA.

Plots	Treatment	Yield per Acre			Gain Over Adjoining Plots Receiving No Phos. Acid	
		Cane	Q. R.	Sugar	Cane	Sugar
XX	Nitrogen and Potash	45.8	7.29	6.28	+ 1.9	+ 0.47
X	Nitrogen only	43.9	7.56	5.81		
A	N. and K_2O + 30 lbs. P_2O_5	56.3	7.80	7.22	+ 10.3	+ 1.01
X and XX	N. and K_2O + No P_2O_5	46.0	7.41	6.21		
B	N. and K_2O + 60 lbs. P_2O_5	66.6	8.25	8.07	+ 24.1	+ 2.35
X and XX	N. and K_2O + No P_2O_5	42.5	7.41	5.72		
C	N. and K_2O + 90 lbs. P_2O_5	70.2	8.03	8.75	+ 23.1	+ 2.41
X and XX	N. and K_2O + No P_2O_5	47.1	7.41	6.34		
D	N. and K_2O + 120 lbs. P_2O_5	66.7	7.43	8.98	+ 23.0	+ 3.06
X and XX	N. and K_2O + No P_2O_5	43.7	7.41	5.92		

1918 CROP, D 1135.

Plots	Fertilizer—Pounds per Acre			Yield per Acre			Gain Over Adjoining X Plots	
	Nitrogen	P_2O_5	K_2O	Cane	Q. R.	Sugar	Cane	Sugar
A	200	30	20	59.42	9.68	6.14	+ 7.67	+ 0.68
X	200	0	0	51.75	9.47	5.46		
B	200	60	40	60.52	9.71	6.23	+ 10.09	+ 0.78
X	200	0	0	50.43	9.26	5.45		
C	200	90	60	64.83	10.51	6.17	+ 15.75	+ 1.40
X	200	0	0	49.08	10.28	4.77		
D	200	120	80	65.54	11.02	5.95	+ 17.85	+ 1.37
X	200	0	0	47.69	10.19	4.68		

1920 CROP, D 1135.

Plots	Treatment	Yield per Acre			Gain Over Adjoining Plots Receiving No Phos. Acid	
		Cane	Q. R.	Sugar	Cane	Sugar
X	Nitrogen and Potash	72.6	7.53	9.64	+ 3.5	+ 0.25
XX	Nitrogen only	69.1	7.36	9.39		
A	N. and K_2O + 30 lbs. P_2O_5	78.7	7.17	10.98	+ 11.1	+ 1.92
X and XX	N. and K_2O + No P_2O_5	67.6	7.46	9.06		
B	N. and K_2O + 60 lbs. P_2O_5	89.5	7.73	11.57	+ 18.5	+ 2.00
X and XX	N. and K_2O + No P_2O_5	71.0	7.46	9.57		
C	N. and K_2O + 90 lbs. P_2O_5	91.0	7.59	12.22	+ 15.0	+ 2.02
X and XX	N. and K_2O + No P_2O_5	76.0	7.46	10.20		
D	N. and K_2O + 120 lbs. P_2O_5	99.5	7.21	13.79	+ 31.7	+ 4.71
X and XX	N. and K_2O + No P_2O_5	67.8	7.46	9.08		

The addition of potash made very little difference in the yields, as shown by comparing the yields of the X and XX plots. This was to have been expected, as these soils are high in potash, containing about 0.8% of total acid soluble K_2O.

As all the plots received equal amounts of nitrogen, 200 pounds per acre, the rather large gains in cane and sugar for the different treatments are due almost entirely to the addition of phosphoric acid. Each increase in the amount of phosphoric acid applied produced a further gain in sugar up to the limit of phosphoric acid application, which was 120 pounds per acre of P_2O_5.

We plan to add larger amounts of phosphoric acid to the next crop to determine what the profitable limit is on these lands.

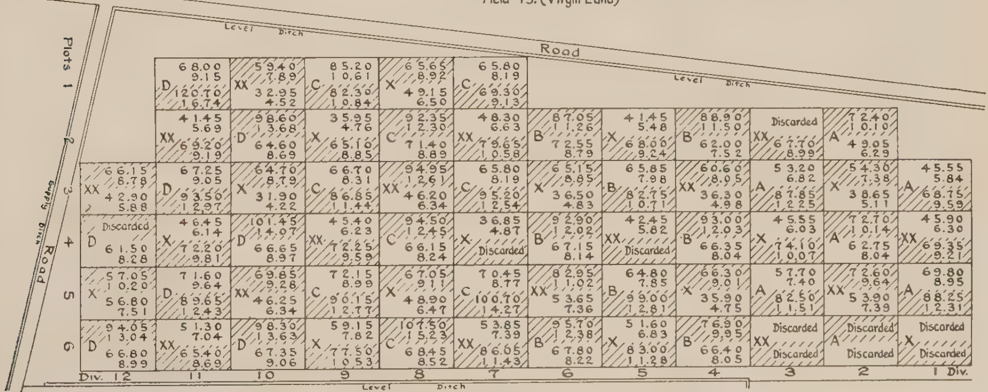
The general plantation practice on these fields has been to put on about eight hundred pounds of so-called "high-grade" fertilizer per acre.

This fertilizer contains about 8% P_2O_5. This gives 64 pounds of P_2O_5 per acre. Assuming similar conditions as those of the experiment (chemical analyses indicate that practically all the upper red soils of that district are of that nature), the addition of 60 pounds more per acre of P_2O_5 should increase the yield of, say, H 109, D 1135, or H 456 by one or two tons of sugar when all other conditions are favorable. Sixty pounds of P_2O_5 would be supplied by 320 pounds of acid phosphate, and would not cost more than five or six dollars per acre.

AMOUNT OF COMPLETE FERTILIZER TO APPLY.

Oahu Sugar Co. Exp. 4, 1920 Crop

Field 45. (Virgin Land)



Summary Yields For Each Treatment.

Plots	Fertilizer Elements Applied Lbs. P. A.			Yields Of Sugar Tons Per Acre.			
	Nitrogen	P_2O_5	K_2O	Lahaina	Gain Over No Phos. Acid	D1135	Gain Over No Phos. Acid
XX	200	-	40	628	+ 047	9.64	+ 025
X	200	-	-	581	-	9.39	-
A	200	30	20	7.22	+ 1.01	10.98	+ 1.92
X. XX	200	-	40	6.21	-	9.06	-
B	200	60	40	807	+ 235	1157	+ 2.00
X, XX	200	-	40	5.72	-	9.57	-
C	200	90	60	8.57	+ 223.	12.22	+ 2.02
X, XX	200	-	40	6.34	-	10.20	-
D	200	120	80	8.98	+ 306	1379	+ 4.71
X, XX	200	-	40	5.92	-	9.08	-

Key:-
Ruled Area = D1135
Clear Area = Lahaina

In the experiment discussed above, dealing with both D 1135 and Lahaina cane, the yields of the D 1135 exceeded those of the Lahaina by 50%. The average yields of all plots were as follows:

Variety	Tons per Acre		
	Cane	Q. R.	Sugar
Lahaina	52.88	7.63	6.93
D 1135........	78.28	7.42	10.55

It is also interesting to notice that, not only were the yields of the D 1135 50% better than those of the Lahaina, but that the juices of the D 1135 were better than those of the Lahaina. This cane, as previously mentioned, was harvested very late and was very dry when harvested. Two years ago, this same field was harvested in March, after a very wet winter. The quality ratio of the D 1135 was then very nearly ten. This would seem to indicate that the quality of D 1135 juices can be very materially improved by properly drying the fields before harvesting.

J. A. V.

A Natural Enemy of Mosquito Larvae.

Very few invertebrate enemies of mosquito larvae have been recorded, and it is therefore of interest to know that in Buenos Aires there is a planarian worm that attacks them. The following summary of the original paper by A. B. Lischetti appears in the October number of "The Review of Applied Entomology":

"The fact that 30 larvae of *Stegomyia fasciata* (*Aedes calopus*), placed in a glass tank of water for breeding purposes, disappeared within two days led to investigations to determine the reason. Thirty larvae of *Culex* sp. introduced into the tank suffered the same fate, only a few fragments being left. An examination of the flora and fauna of the water was then made, and revealed among other things a number of worms of the genus *Planaria*. The fact that young mosquito larvae disappeared completely and that only the harder portions of older ones were left, indicated that they were devoured by the *Planaria,* which was the only living organism in the water capable of such action. Experiments were then made with 100 cc. drinking water into which were placed six *Planaria* worms, and in successive batches of about 10 to 20, 108 larvae of *Culex* sp. from 3 to 4 mm. long. A table shows the length of time taken to dispose of the various batches of larvae; within four hours the six *Planaria* had devoured a total of 106 larvae, only two particularly large individuals escaping the general fate. The same six *Planaria* were immediately transferred to another vessel containing 200 *Culex* larvae of 4 to 5 mm. length, which they immediately attacked and continued devouring with short intervals of rest. By midnight many larvae were dead or dying, and by 8 a. m. next day all had either disappeared or were clinging to the bottom or sides of the receptacle.

"The habits of these worms have been studied, and are described. The presence of mosquito larvae in the vicinity causes some excitement among them, and the larvae are attacked when their siphons are brought to the surface for a few seconds. The worm applies one of the lateral lobes of its head to the siphon of the larva, to which it adheres by means of the viscous substance with which it is covered. If the larva tries by means of its mouth-parts to rid itself of its enemy, as is frequently the case, both mouth-parts and siphon adhere to the worm, which, as soon as it has secured its prey, drops with it to the bottom of the receptacle. It then punctures one of the larval segments and drags out the whole body content of the larva, leaving only the head and skin. Adult larvae, on account of their strength, and pupae on account of their activity, can almost always escape the attacks of *Planaria*.

"The experiments described indicate that this natural enemy might be used artificially for the destruction of mosquito larvae, but further information must be obtained regarding the distribution and habits of the worm, its resistance to meteorological conditions, etc., before its value in this connection can be determined. The present notes are given with the object of interesting students in the question and suggesting a field of investigation to them."

F. M.

Effect of Salt on Cane.

OAHU SUGAR COMPANY EXPERIMENT NO. 20 (1920 CROP).*

SUMMARY.

This experiment was planned to determine the effect of common salt (NaCl) on the growth of cane and on the quality of the juices. As originally laid out, this experiment involved Lahaina and H 109 for the crop of 1918, but the combined effect of Lahaina disease and eye-spot was so serious that no results were obtainable.

After harvesting the 1918 crop, the H 109 area was replanted with D 1135 and the same experiment continued for 1920 crop on Lahaina and D 1135. Again Lahaina disease so damaged the Lahaina area that only the D 1135 was avilable from which to secure data.

The treatment for both crops consisted of applying salt at the rate of 0, 2000, and 20,000 pounds per acre to each crop in 20 equal applications at two-week intervals. All plots received uniform fertilization, for the 1918 crop consisting of 750 pounds complete fertilizer and 484 pounds of nitrogenous mixture, and for the 1920 crop, consisting of 800 pounds complete fertilizer and 525 pounds nitrogenous mixture.

The addition of 2000 pounds of salt per crop seemed to have had little or no ill effect on the yield, but the addition of 20,000 pounds has caused a loss of 7.95 tons cane or 1.38 tons sugar. The following tabulation shows the yields for the different treatments and also the gain or loss when compared with the adjoining X plots:

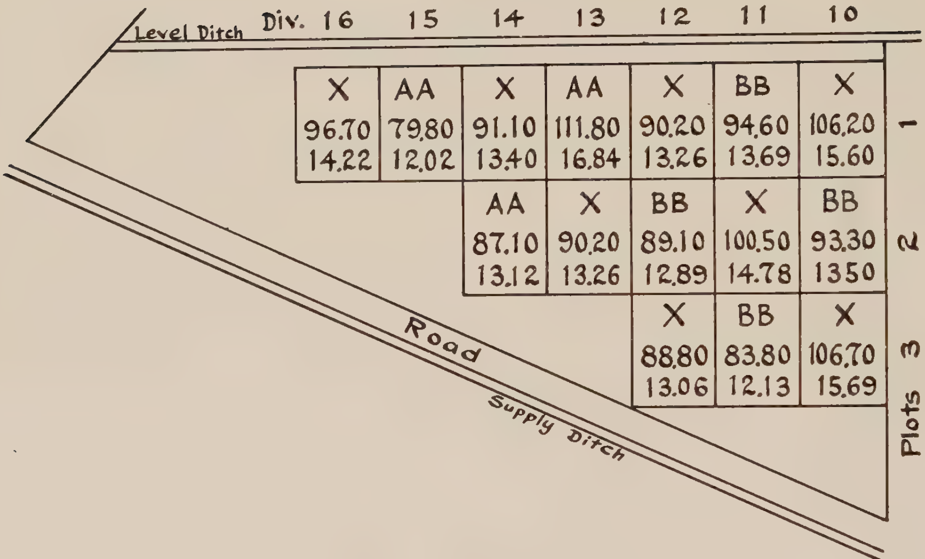
Plot	Treatment	Yield—Tons per Acre		Gain or Loss in Tons Over Adjoining X Plots	
		Cane	Sugar	Cane	Sugar
AA	1 ton salt per acre per crop..	92.9	13.99	+ 1.39	+ 0.53
AX	No salt	91.5	13.46		
BB	10 tons salt per acre per crop	90.2	13.05	— 7.95	— 1.38
BX	No salt	98.15	14.43		

From this tabulation one might be led to believe that a small amount of salt had a stimulating effect on the cane. However, a detailed study of the plot yields shows that this apparent greater yield is caused by one plot. Upon discarding this exceptionally high-yielding AA plot, a slight loss in both cane and sugar is shown.

Salt seems to have had no effect on the juices. While there are slight

* Experiment planned by L. D. Larsen and harvested by Y. Kutsunai.

Effect Of Salt On Cane Growth
Oahu Sugar Co. Exp. 20, 1920 Crop
Field 49 (New Land)



Summary Of Results

Treatment	Yields Per Acre			Gain or Loss Over No Salt Plots	
	Cane	Q.R.	Sugar	Cane	Sugar
No Salt	91.51	6.80	13.46		
1 Ton Salt	92.90	6.64	13.99	+1.39	+0.53
No Salt	98.15	6.80	14.43		
10 Tons Salt	90.20	6.91	13.05	-7.95	-1.38

variations, they are so small as to be within the limits of experimental error. The following shows the juices obtained:

Treatment	Brix	Pol.	Pur.	Q. R.
No salt	22.56	19.59	86.84	6.80
1 ton salt.......	23.09	20.03	86.75	6.64
10 tons salt.....	22.78	19.45	85.38	6.91

DETAILS OF EXPERIMENT.

Object: To determine the effect of common salt (NaCl) on the growth of cane and the quality of the juices.

Location: Field 49, Section 11, Divisions 10 to 16 inclusive.

Crop: Lahaina and D 1135, first ratoons, long; plant crop was on virgin land.

Layout: No. of plots, 15. Size of plots, 1/20 acre each (39.5′x 55′), consisting of 10 single rows. Each plot is one watercourse wide.

Plan:

X plots, 0.

AA plots, 2000 pounds NaCl per acre.

BB plots, 20,000 pounds NaCl per acre.

This salt to be applied in 20 doses at intervals of about two weeks.

Fertilization: Uniform to all plots, as follows:

August, 1918, 400 pounds C.F.; October-November, 1918, 262.5 pounds N.M.; February-March, 1919, 400 pounds C.F.; May-June, 1919, 262.5 pounds N.M.

C.F. = 10% N. (7% sulfate, 3% nitrate), 8% P_2O_5, 1% K_2O.

N.M. = 18% N. (½ nitrate, ½ sulfate).

PROGRESS OF WORK.

July 7, 1918—Cut back.
August 28, 1918—First fertilization and first application of salt.
November 6, 1918—Second fertilization and sixth application of salt.
February 24, 1919—Third fertilization.
February 28, 1919—Fourteenth application of salt.
May 22, 1919—Twentieth application of salt.
June 5, 1919—Fourth fertilization.
August 5-7, 1920—Experiment harvested by Y. Kutsunai.

R. S. T.

Japanese Canes. *

By D. W. May.

We have at the station (Mayaguez, Porto Rico) two varieties of cane that came out of India, but generally known as Japanese canes. They are very nearly alike, having peculiar characteristics quite different from other canes commonly grown on the island. They are very slender, but stool heavily, and soon cover the ground. They have been grown to some extent in the Southern States as forage principally. Their outstanding feature with us, however, is that they are free from the matizado or yellow stripe disease, which is causing us concern at this time. When the matizado first began to appear extensively in Porto Rico, the station brought from St. Croix several tons of the variety known as Kavangire, while it already had some of the variety known as Zwinga, which we were growing for forage for our cattle. Since a great deal of these canes have been planted, especially on the western end of the island, where the matizado has given us the most trouble, it is well to look into their value from a sugar-making standpoint to determine whether we shall extend the plantings or gradually eliminate them.

It cannot be said that these are first-class milling canes. From the standpoint of plant improvement they may be said to be wild canes. This is indicated by the smallness of the stem and the amount of trash. In the West Indies we are prone to look upon a cane with a small stem as undesirable, and in all our cane-breeding work we have sought large canes. In the East Indies, where labor is cheaper than with us, and where a great many women and children are employed in the cane fields, they pay more attention to canes that stool well; that is, that give a great many stalks in the hill. It is this that we consider the greatest defect of the so-called Japanese canes. On the other hand, we find that these

* From Agr. Ext. Notes, Porto Rico Agr. Exp. Sta., No. 31, Jan., 1921.

canes give a large tonnage and have a further advantage of tillering and growing so rapidly as to quickly cover the ground, shading it so that weeds and grasses cannot grow and less cultivation is therefore required. On the other hand, the variety Kavangire takes longer to mature than the canes usually grown in Porto Rico. Under twelve months this cane tested from 9 to 13 per cent sucrose and from 60 to 80 per cent purity. At fifteen months it averaged 14 per cent sucrose and 86 per cent purity. At eighteen months, or *gran cultura*, it ran up to 15.9 per cent sucrose. In this connection it is advisable, where possible, to follow the growth of the cane with chemical control. In Java in many instances they test their canes for ripeness by drawing stalks and making polariscope tests from time to time to determine when it is at the best stage for harvesting. It might be advisable for us to follow the same practice. It is especially valuable with the Kavangire cane and also with the Rose Bamboo and Yellow Caledonia. These canes are long in maturing, and with the Bamboo cane especially, as it does not arrow, it is difficult to determine by appearance when it is at the best for cutting. If cut too soon or too late the glucose ratio is very high.

A mill test was made at Guanica of 2.23 acres of the Kavangire cane harvested about three months before it was planned to cut the same, due to its having been burned. It was 14 months old when cut. The yield was 44.75 tons per acre. The normal juice ran 13.70 Brix, 10.59 sucrose, 77.31 purity, and 1.76 glucose. The total sugar recovered per acre was 3.53 tons.

At the same time the Kavangire cane was cut, there was harvested, from the same tablón at Santa Rita and alongside, seedling cane D 117. The yield was 49.7 tons per acre. The analysis, Brix 15.72, sucrose 13.24, purity 84.22. Yield of sugar 96° was 5.25 tons per acre.

In our first planting of the Kavangire cane at the station September, 1917, harvested January, 1919, the yield was in holes five feet apart, 95.9 pounds per hole. This calculated at the acre rate would amount to 83.56 tons. Several tests were made, grinding the cane in a small hand mill. The average sucrose was 12.2 per cent, purity 81.23 per cent.

In a field of the other variety of so-called Japanese cane known as Zwinga, planted on high land for forage, the yield in 7 months 10 days was 33⅓ tons per acre cut for cattle. This cane would have grown much larger if it had been allowed to mature. The results are given here to show that these canes are of value as forage and may be utilized profitably for that, should the price of sugar drop to a point where it would not pay to harvest them.

Therefore, in summing up the matter, we would advise our cane growers to give these Japanese canes, known as Kavangire or Yuba and Zwinga, a further trial, especially as the matizado disease is giving us some trouble, although the conditions are improving. We should bear in mind the fact, however, that we should continually seek for better canes than we are now growing. With the hundreds that are coming out every year propagated by plant breeders in various tropical countries, we should continually seek those that will give us the greatest amount of sugar with the minimum amount of labor. In doing this we should not take the results in any one country or any one locality, because some varieties of canes will do best in certain situations or on a given type of land, while an entirely different one will give best results under other climatic conditions or even on a different soil on the same estate.

[H. P. A.]

An Ilongot Cane Press.

The illustration shows a primitive device for extracting juice from cane. The photograph is furnished us by Mr. C. E. Hoye, associated with the public school system of the Philippines, who says that the cane press is "in use among the Ilongots of north Luzon—perhaps our wildest Malay tribe—where I was stationed two years ago. It is worked by foot pressure on the string, which sets

the pole swinging up and down, when the cane stalks are pushed between the pole and the block of wood. So far as I know the juice is only used as a fermented drink. The cane grown there is the largest in the Philippines, I believe; the people tie the stalks to the trees to keep them standing upright; the land in this section is entirely public land and the valleys are extremely fertile. A meter wide trail is now being built across this country, the first attempt to open it up."

H. P. A.

Ultraviolet Rays and the Sugar Cane, Pineapple, and Banana Industries.*

By T. Tsuji.

The author, studying the action of the ultraviolet rays on chlorophyll in sugar cane, found that germinated and intact canes cultivated in moist soil with exclusion of light at 22° C. (71.6° F.) grew but remained etiolated for 30 days. After this period, one-half of these plants were exposed to direct sunlight, the other half to the ultraviolet rays of a quartz mercury vapor lamp of 110 volts and 4 amperes for 2.5 hours. The former plants remained yellow, while the latter assumed a deep green coloration.

Of three rows of sugar cane, one was so shaded with colored glass as to decrease by 50 per cent the ultraviolet rays of the sun; the plants of the second were exposed to open sunlight; those of the third were exposed to the ultraviolet rays of the sun and of a weak mercury lamp. Fertilization was the same in each case. After some months of growth, the plants of the first row had gained 1.25 pounds; those of the second, 2.8 pounds, and those of the third, 3.33 pounds. These results, and the fact that the period of growth to maturity was reduced from 20 to 11 months, suggest the practicability of using ultraviolet rays for increasing cane crop yields and decreasing the time required per crop in Hawaii.

It is claimed that the action of ultraviolet rays on carbon dioxide and hydrogen in the nascent state in the presence of potassium hydroxid determines a photosynthesis. The formaldehyde thus produced is condensed to sugar under the influence of the rays, and carbon dioxide and water vapor are also combined to form sugar and other carbohydrates. The canes in the second row above mentioned had 30 per cent and those in the third row 38 per cent more sugar than those in the first row.

The influence of ultraviolet rays in producing sulfuric acid from sulfur dioxid, oxygen, and water is mentioned in connection with suggested possibilities.

Ultraviolet rays with carefully-controlled daily exposure lasting for 40 minutes were found to ripen pineapples more completely and satisfactorily than was usual for these fruits.

Etiolated banana leaves developed in five hours a deep green color. Banana leaves and stalks exposed to ultraviolet rays after being cut and kept in water remained perfectly fresh for two weeks, at least twice as long as those kept in diffused daylight. This is thought to indicate a means of preserving and ripening with improvement bananas for shipment to distant points.

The problem is how to produce and employ practicable apparatus for the application of the shorter ultraviolet rays to sugar cane, pineapple, and banana culture.

[H. P. A.]

* From Exp. Sta. Recd., Vol. 43, No. 8, p. 730. Original appeared in La. Planter, 60 (1918), No. 26, pp. 413, 414; also in Gard. Chron., 3, ser., 66 (1919), No. 1719, p. 283.

The Sugar Cane (Arundo Saccharifera). Tubu.*

In passing, I must give an account of sugar cane also, for there are various plants in this collection which are compared with it. I have, too, certain additions to make which are not found in the books of Europeans, and I shall explain certain questions and difficulties which arise in connection with this reed.

The sugar-cane plant, as it is cultivated in India today, is a stalk of equal thickness, curving a little at the bottom, and growing, with no lateral branches, to a height of eight, ten, and twelve feet, though I have seen some stalks as long as seventeen feet. Generally it is as thick as two fingers, sometimes as thick as two thumbs. It is divided into many short sections, three, four, and five horizontal fingers long, and bulging a little in the middle. The lower part is bare, while the upper part bears at each node a large leaf. This leaf is much larger than in all other kinds of reeds, being four feet long, three fingers wide, running to a sharp point at the end, striated lengthwise, with a flat white vein in the center, wrinkled to the touch and sharp enough to cut along the edges, of a pale gray-green color.

It never produces flowers and seed unless it has stood for several years in a stony place. Then a large reed-like panicle grows out at the top, as in Sorghum, but much lighter, composed usually of soft white down in which lies hidden the chaff-like seed.

In these Oriental countries I have seen three species of sugar cane, differing in no way except in the color of the stalk.

The first and most common species is the white with very long joints, more than five horizontal fingers long, usually light yellow or white on the outside. This species has a very thin rind, yields a very large amount of juice, and supplies the most sugar.

The second is the brown or red species. It has very short joints, a rather hard rind and pith, and on the outside is brown or striped with brown and white, but always in such a way that the predominating color is brown. This kind gives less juice, but is sweeter than the preceding. Some wish to make another species of that cane which has a rather thin stalk, striped on the outside with brown and black. From this they call it the black cane. Its leaves have a brown midrib.

The third species has a very thin stalk and rind, is not more than a thumb thick, and has green stripes and long joints. It has very sweet sap and yields a very large amount of sugar. It is therefore extensively cultivated by the people of Java, around Zuroebaja, for its sugar.

All three of these species are filled with a sweet, watery, spongy pith which is made up of long fibers in such a way that its sweet juice can be easily sucked out if the hard rind is first removed. In all other particulars, the form of this (reed) is sufficiently well known.

There are two methods of cultivating sugar cane. The first is that of the Javanese. They take a large level tract, well exposed to the sun, damp and warm, where the soil is soft, brown and rich, and turn it up with a plow. They mark

---

*Rumphius, Herbarium Amboinense, Book VIII, Chapter XXVI. (Published in 1750.) Translated from the original Latin by Miss Susan G. Clark.

these fields off in furrows, just as we do those in which cabbage is planted. In the raised ridges, on both sides, are stuck ends cut from the old stalks of sugar cane, or the shoots which grow here and there from its nodes. A little of each joint is left, but the leaves are cut off all around.

These ends, placed in the ground four, five or six together, obliquely or in circles, send out roots and producé new stalks which mature in the ninth or tenth month. They do not wait for the flowers to come out, however, for by that time the cane has lost its best juice.

The second method is best suited to regions where they do not wish to secure a large amount of sugar, but to use the cane for food. It is done by placing old stalks in the ground, just as with the grape-vine. Two furrows are made, or parallel ridges. In each an old stalk is placed and covered with a little earth. Then, from almost every node a new plant starts which grows into a new stalk. If these are too close together, here and there one or two are cut off. When these stalks come up the ground must be carefully freed from all other growing vegetation, in order that the cane may be thriftier.

The people of Amboina do not spend much labor on planting this reed. They just dig holes about half a foot deep here and there, after they have first gone over the ground and burned all standing vegetation. In these holes they place these ends or shoots, four or six in a circle. When these grow out they again weed the ground. They cultivate this cane in the way just mentioned.

I have learned that in western India, by setting out stalks, sugar cane can be grown in one and the same field for five years before new land is required.

In these islands this cane does not last for more than three years. Then it dies. Also, the same land cannot be used for more than three consecutive years. The Javanese cut off the ripe stalks in such a way that three or four nodes are left above the ground. From these, new stalks again grow out, and so they can gather this cane twice or three times from one field before this (the field) is changed, but the last crop is in no way as rich as the first.

The stalks which have been cut and stripped of leaves are crushed between two rollers made of hard Cussambi wood, one of which is turned by caribao. Then the juice which has been pressed out is carried by a flume made of caribao hide to large vats. From these it is carried to others to be cooked. These vats have on the lower side an iron kettle which rests on an oven. The sides of this kettle are supported by bricks built up high and obliquely, and so plastered over with lime that the whole thing looks like a huge kettle.

Into this kettle the juice is poured and under it a hot fire is built. As it boils down they add new juice, letting the fire die down gradually, until the juice is brown and viscid. Then they pour it into deep earthen pans or large earthen jars, which are placed in a large smoke-room, where it is dried into sugar. The upper part is white and lumpy. From this it is called cake-sugar. The lower part is yellowish-brown and is called muscovado sugar.

From the white sugar the Chinese make sugar-candy. They melt the sugar again in a large kettle, mix with it the whites of eggs, carefully stir it, and finally add a little chicken fat, saying that this is required to make the sugar clear.

The Chinese in their own country, or living in places where there are no Moors (meaning Brahmins?), take melted lard instead of chicken fat. But they hide this (practice) from that nation, that they may not lose their trade, for the

reason that the Moors generally refuse to eat this sugar unless they are convinced that it has been made and prepared by their own people.

Furthermore, let everyone who buys any sugar in Java, packed in baskets, be warned to examine these first with due care, for the deceitful nation of the Chinese is wont to place good sugar on top, but dirt, ashes or dried leaves below. Sometimes, too, they mix muscovado sugar with the black palm-tree sugar, made from the Saguer palm, or they boil these two juices together, a fact that is discovered when it becomes moist and slimy.

After the sugar-candy is boiled it is poured into pans or jars in which a wicker (screen) made of split cane or bamboo has been placed. To this the sugar adheres and hardens, and as a result it sometimes happens that small bits of cane fiber are found. These are not the bristles of pigs, as some falsely believe.

From the whitest and best sugar there is made a very fine hard sugar-candy, like crystal, which is called masculine sugar. From the cheaper dark sugar a yellow sugar-candy is made which is much more brittle and less choice, but which, at the same time, is richer and sweeter than the former. This is called feminine sugar.

In China the third species of cane is most common. It has a very thin stalk and rind, you remember. The Chinese call this *Tecsia,* from the word *Tec*; that is, *Bamboo.* They use it solely for obtaining sugar. All other coarser, larger sugar canes they call *Camsia,* or, by a better pronunciation, *Gamsia.*

Tecsia is scarcely a thumb thick, generally yellowish like the *Boeloe Swangi,* and so soft and tender that its rind can easily be bitten into and split lengthwise. Its species is *Toeboe Marasoli,* brought from Boeroe to Amboina. This cane, too, is yellowish, marked with a few green stripes. It is said to have been brought to these islands from Ternata by one Huccum Marasoli. Very often this cane deteriorates and becomes short-jointed, with a hard rind like the common white sugar cane. In my opinion they are merely two varieties of the abovementioned third species.

Names: Latin, *Arundo Saccharifera.* Malay, Javanese and Baleya, *Tabu* and *Tebu,* from its many nodes. In Amboina and Bandas, *Tewa.* In Ternata, *Uga.* Chinese, *Camsia.* The condensed juice is called in Latin *Saccharum* and *Zuccharum.* Malay, *Gula,* or more properly *Sacchari,* and the sugar-candy *Saccar,* or *Gula Batu,* meaning rock-sugar. In Chinese, *Tung,* and the sugar-candy *Tungsung.*

The word *Gula,* if not of Persian origin, may be derived from the Arabian *Cohl,* meaning thickened juice.

The word *Jagara* or *Jagare* is very similar to the word *Saccharum.* By it the people of Hindustan mean any sugar which is made from the sap of trees, especially of the Lontar tree, and it is uncertain which is the older word among the Indians, *Saccharum* or *Jagare.* Above, in Book I, Chapter 8, we say that in our opinion *Jagare* is the oldest, because, without doubt, the practice of boiling sugar from the sap of the Lontar and Calappus trees was the oldest, making *Jagare* the earliest word. But now that we think of it again, the word *Saccharum* was known to Pliny and Dioscorides, and from their descriptions it may be decided that their *Saccharum* had nothing in common with the poor quality *Jagare* generally called by us black sugar. Now, from this I should conclude that

Saccar is the oldest and first Indian work, and that *Jagare* was either derived from it because of the similarity of sound, or is a distinct word, quite apart from it. The art of making sugar from the sap of trees is not so old among the Indians.

Concerning the place and use of sugar cane we shall not say much here, merely mentioning that this cane is extensively cultivated in Bengal, Siam and Java for making sugar. In Bali, Celebes and the Moluccas, syrup is made from it. This is properly called *Gula,* and is used in foods, but it serves our people as beer. In Amboina and other islands of the east where the sea air is rather cool and the soil poor, the cane is correspondingly thinner and poorer. It is not cultivated much, and is generally eaten in its raw state.

Goela, or the syrup made from sugar cane, is called in Ternata *Manis,* and is chiefly used for making the drink *Kilang.* The thin syrup is poured into jars and a small dish of mash of beer or of some other drink is added to it. In this way it is allowed to ferment for several days. After this three or four crushed roots of Lanqua are put in, and again it is fermented. Finally a little bundle of Cumin and Cinnamon is added, and then for a month it is left to itself, half buried in the ground. The jar must not be sealed, lest it burst. This drink readily intoxicates, but causes no headaches. Men grow fat on it, and the men of Timor and Rotte make this their boast for their *Goela,* which they make from the Lontar and call *Coli.*

Muscovado sugar and sometimes even the rind of the cane itself are mixed with *Doepa* and *Astangi,* and give forth a sweet fragrance when placed on live coals.

For the rest, we shall set forth in passing some curious questions and explain them according to our best judgment. First, was our sugar known to men of antiquity; second, what is the difference between our sugar and theirs; and third, when did our sugar come to the knowledge and use of the western world.

As to the first, we thoroughly agree with Matthiolus in his Commentaries on Dioscorides, Book 2, Chapter 75, on honey, and we say with him that the sugar mentioned in this chapter of Dioscorides, and which was barely known to the men of antiquity, was condensed juice or *Gummi,* taken from this same cane from which we today secure and prepare sugar, as Dioscorides' words in the passage cited clearly show, that is, was secured from cane.

In answer to the second question, we say that, although the sugar of the ancients was secured from this same cane, there is nevertheless this difference between theirs and ours. Theirs was condensed juice, like drops of gum, white, brittle, easily crumbled in the mouth, and having the form of fine salt. For this reason it was called by them Indian salt. It had to exude of its own accord, under the heat of the sun, from the old stalks of cane, and harden around the nodes. The tear-like drops were never larger than a filbert, and so in the days of Pliny sugar was very expensive. Without doubt, at that time the process of making sugar was not yet known to the natives, who were satisfied with that which nature produced from this plant and gave them of her own accord, until they learned the process mentioned either for the sake of profit or from the Chinese. At any rate, even to this day sugar is prepared in Java by the Chinese. In reply to this, perhaps some one will ask why such drops of sugar, produced

by nature, are no longer found. I answer that the sugar cane now does not become so old. No longer is it left to itself, as it becomes woody and loses its best juice if it stands a year or two. This could even happen to cane growing in the fertile parts of Arabia and in Hindustan, places which are much warmer than these islands of the Indian archipelago.

Moreover, Matthiolus clearly testifies that this was observed in the same way in his day in some countries, where in his commentaries he writes that he had heard from trustworthy eye-witnesses, men who had traveled over the islands of St. Thomas and Madera, that in these places sugar was found condensed in the cane itself, from which it exudes like gum, not unlike that which is called sugar-candy and which is artificially made. But to this Salmasius objects, in his treatise on sugar, published after Solinus. He is strongly of the opinion that the sugar of the ancients was nothing other than the Sackar Mambu, the Tabaxir of the Persians, since they say with full agreement that sugar comes forth from certain reeds. But I cannot accept this statement, since it is well known that sugar cane is considered both as a reed and as a bamboo. And, besides, as I have already said, the stalks of cane, for the most part bending down to the ground and lying on it, were considered as roots. Then, too, never have I read or heard that Tabaxir had in itself any noticeable sweetness. Certainly that which I have found and tasted in Amboina showed no sweetness, and resembled dry starch more than sugar. Besides, we find in the writings of the ancients that people of India made a drink from the roots of sugar cane. Marcus Varro bears witness to this fact in the following verses:

> The Indian cane grows like a rather small tree,
> And from its tough roots a juice is pressed,
> With which sweet honey cannot vie.

With these, Lucanus' verse agrees:

> Who drink the sweet juice from the tender cane.

But no one ever heard of a sweet drinkable juice being secured from bamboo or from any other tree-roots.

Besides, there was another sugar known to the ancients, poorly described and confused with the former. About this, Solinus writes that in the swampy places of India reeds grow so large that from one central joint, cut through the middle and split, a small canoe can be made, in which the Indians navigate large rivers. From the roots of this a sweet honey-like juice is pressed. In my opinion it is thoroughly established from these statements how that Saccar Mamboe which lies in the nodes or hollow grooves and not in the roots of the Indian Mambu or Bamboo and which grows only in the province of Bisnager—for which look up Book 6 in the chapters on reeds—is mistaken for that which is gathered from sugar cane. I think that it was gathered at a time, perhaps, when the stalks of this reed were considered to be roots, for no roots are known from which sugar or syrup can be secured. As an additional proof of the former statement it may be added that Dioscorides attributes to his sugar the same quality which is today seen in ours—it mollifies the stomach and makes the eyes clear, which is the reason why sugar-candy is used today, dissolved in French wine.

In answer to the third question, we can only say that Actuarius was the first to mix sugar with medicinal powders and compounds. From this we can conclude that in those times sugar must have been imported in larger quantities than in the age of Pliny and therefore that the process of making sugar from extracted juice must have been known then.

It should be understood—and this is a warning already given by others—that Saccharum candidum or sugar-candy in no way takes its name from its white color, which in Latin is *candidus,* for we find brown, red and yellow sugar-candy. The name comes from the Greek word *κανθος* (canthos), which signifies in the Greek of today as well as in various other languages of Europe, a prism, since this sugar is always full of angles like polished adamant or crystal, and for this reason it is fittingly to be called Saccharum canthi.

PLATE LXXIV

In the first drawing the true sugar cane is shown.

The second drawing shows the Rottanga sugar cane, or Tabu Rottang.

P. S.—This Tabu Rottang is scarcely a thumb thick. In its upper half many straight shoots grow out, which have very narrow leaves. These, too, are straight, differing from the leaves of the preceding plant. In fact, they agree with those of Carex. They have a thick midrib, and are the width of the little finger and more than three feet long. Above these shoots are the common leaves, three fingers wide and from four to five feet long. Above these is the usual panicle, which in this species is divided into two or three spikes.

Observation.

This plant is called simply *Saccharum* in H. Cliffort, p. 26, and *Arundo Saccharifera* in Sloane, Cat. pl. Jam., p. 31, who has almost innumerable authorities this plant. In J. B. and Sam. Dale Pharmac. in 4to, p. 291, it is *Arundo Saccharina.* This author mentions various kinds of sugar juice.

[E. L. C.]

Millets for Fodder on Sugar Estates.*

By C. A. Barber, C.I.E., Sc.D., F.L.S.

I.

In a recent "Agricultural Note" attention was drawn to the importance of improving fodder supplies on sugar estates, and it was suggested that lessons might be learnt from the indigenous dry farming practised in the East, where with scanty supplies of water and on comparatively poor soil large quantities of food and fodder were habitually grown in the struggle for existence. Millets are the main crop in such dry regions, and it is estimated that one-third of the popu-

* From The International Sugar Journal, Vol. XXII, Nos. 263 and 264, p. 613.

Pag 191

Tab LXXIV

Tom V

lation of the world is interested in their cultivation. As an accessory fodder and food crop some form of millet is probably far and away the most economical and productive. But these crops are little known in sugar-growing countries, and it is with the idea of placing the facts dispassionately before planters that the present study has been prepared. After a few remarks on millets in general, it is proposed to deal with one of them as a type and then add notes on the others as occasion may arise.

The millets occupy a very distinct place in tropical agriculture; they are the indigenous dry-land cereals of the tropics, and especially of the Old World. Maize generally takes their place in the New World, but this is essentially a sub-tropical staple; wheat, barley and oats are temperate cereals, and when they penetrate into the tropics they are generally grown on the outskirts, as in Northern India, or in elevated tracts where the climate is not tropical, and then only in the "cold" weather: rice is, of course, tropical, but it is a wet-land crop and the whole methods of its cultivation are entirely special and different from those in crops that are rain-fed.

As is the case with all these crops, millets are occasionally irrigated, especially in tracts with a well-developed agricultural practice, during the dry periods of the year, and very much greater yields are then obtained. But they are essentially rain-fed: they are, all of them, markedly drought resistant, and, maturing quickly, can be grown without irrigation in very dry tracts, where the rains come at only one time of the year: they mature in from three to five months and are thus quite common in regions with less than 20 inches annual rainfall or what are termed semi-arid countries.

Just as wheat penetrates into the tropics and rice into the temperate regions, so the millets sometimes stray outside their tropical limits, and this is the case especially with the Italian or Hungarian millet (*Setaria italica*), which may be found from Europe to the Cape Colony, and may be seen in English botanical gardens in the summer, but this species is more adaptable than the rest.

They all of them have small grains, the giant among them, which will form the subject of this article, *Andropogon Sorghum,* having grains little over one-eighth of an inch in diameter; they may be generally distinguished by their rounded grains and are best known in this country as fowl food or bird seed. In the tropics they form the staple food of the people in the interior, where water is not available for rice growing; they are equally useful for fodder and for cattle and for human consumption; but, as they are only grown for local use, they do not enter largely into export trade.

They form the heart of the dry-land cultivation in Africa, and in Asia are specially developed in India, China, and Japan: there are 40,000,000 acres under millets in India, and the outturn in Japan is given as 35,000,000 bushels every year. They occur where the most primitive and yet intensive dry-farming in the world exists, and their cultivation is therefore associated with old-world simple implements, and they are grown in rotation or as mixtures with pulses, cotton, tobacco and a number of non-irrigated tropical crops.

Sorghum has been selected for detailed study because it is the most important millet: its agricultural needs are greater than some of the smaller forms, but it

can be grown like the rest under unpropitious conditions, while with careful treatment it is capable of a comparatively enormous production as a cereal. It has thus a very wide range of usefulness.

It is chiefly grown for food and fodder, but in America, where it has been introduced from the East, there are forms which are specially adapted for producing sugar syrup and others for making brooms (hence the names "sweet Sorghum" and "broom corn"). This millet can produce great yields under favorable conditions: it is credited with giving "ten times the outturn of most cereals." The grain is an excellent food for man, the stalks are carefully stacked for fodder, and can also be used for fuel if thus required. In the New World it is chiefly grown for fodder, but for grain in the Old World, although it is always used there as a fodder too. The grain is used for cattle and horses, for fattening pigs and for poultry. Sugar is exuded from lesions in the stems and leaves and, as stated, special forms have been developed which produce excellent syrups from the juicy stems.

There is considerable doubt as to the place of origin of Sorghum: it has many wild relatives and is widely scattered in the indigenous cultivation of Africa, India and China. Most probably it was first used in tropical Africa, was thence passed through Egypt to India, and from India to China and Japan; its introduction into the New World is comparatively recent, possibly through the slaves from Africa, as these are known to have brought many of their home plants with them. In India alone have we accurate information as to its distribution: the average acreage for the past seven years was 21,166,166. Bombay has 7,000,000, Madras 5,000,0000, the Central Provinces 4,000,000; thus the Peninsula has two-thirds of the whole, and this emphasizes its tropical nature. In North India its substitutes are maize, wheat and another millet, *Pennisetum typhoideum.*

Botanically, it is a tufted grass, but as grown the stalks are few: this is of advantage as ensuring even ripening, a matter of great importance at the harvest. It is the largest cereal. Because of the mode of growth, usually stems with single heads, there is little separation between the branching and flowering stages which characterize the growth of all grasses. The heads of panicles vary greatly in size and form. When grown for grain, the close round or oval head is preferred, but the open panicle when it is purely a fodder crop. The "irungu cholams" of South India appear to be ideal as a fodder crop, and seed should be obtainable of all varieties by application to the Department of Agriculture in Madras. There are sometimes curious forms, such as the one in which the flower stalk bends down so that the head hangs downwards: it is difficult to trace the origin of this, but it is of advantage as a protection against birds, as they can obtain no foothold. There are two kinds of flowers, sessile which are fertile, and stalked which are sterile. The flowers are proterogynous, that is, the female organs ripen first; this necessitates cross-pollination and the plant is wind-fertilized, a fact which is of some importance as regards the crop. If, for instance, heavy rains occur at the time of flowering, the yield will be very seriously affected. This is a point to be borne in mind with all the millets, and it influences some of the others to a greater extent than Sorghum. The grains are large for a millet, as already noted. In Bombay there is a variety which has

double grains. The glumes, or chaffy outer scales of the grain, vary greatly in color, so that we have black, brown, red, yellow, white and spotted grains, by which differences many of the varieties are most easily recognized. The leaves are broad, like those of maize, two-ranked, wavy edged, with hyaline ciliated ligule, the little membranous protrusion at the junction of leaf-sheath and leaf. The roots are surface feeding, varying in depth according to soil and moisture, i. e., as to whether it is grown as a wet or dry crop. Besides the ordinary soil roots, it possesses a series of aerial roots, which spring from the lower joints above ground; these roots are strong and bend outwards and downwards into the soil where they branch, thus holding the tall plant erect after the manner of tent ropes. A true classification is at present impossible, because of the mixed nature of the fields where crossing has proceeded for ages unchecked. The color of the glumes is a useful character, dry, pithy and juicy, sweet stalks, habit and especially shape of the head, agricultural requirements as to soil and water, length of growing period, drought resistance and so on, all are of assistance in determining the different kinds. It is interesting in this connection to connect the kinds of Sorghum grown with the local races of people: when a native migrates, he takes a few of his own seeds with him, for he finds that the kinds met with do not suit his palate or digestion, and the appearance of a strange form of Sorghum in the fields will often lead to the discovery that such a migration has taken place.

As to environment, all will depend on the character of the rains. Sorghum often experiences conditions which would destroy ordinary cereals such as maize. There must be free drainage, for it will not bear any standing water. Here maize has the advantage, for the writer has seen the crop reaped from boats, where the plants at crop time were under six feet of water. Sorghum has a remarkable power, which is not shared by maize, of remaining quiescent during periods of drought and immediately recovering with a shower of rain. Experiments made in the Great Central Plains region of the United States have shown that Sorghum and bullrush millet require less rain to produce a ton of hay than any other cereal tried. The cultivation of Sorghum is often a triumph of man over nature, both in North Africa and in the east, by taking advantage of casual showers which would be of no use to any other crop but a millet. The Tamil proverb runs: "if you have little to eat, sow cholam."

The preparation of the land and cultivation are simplicity itself. Sorghum can be grown on very poor land, but of course the yield will be affected in such a large plant: it grows best in deep red loam, where a height of 12-16 feet is not uncommon, and black soil also seems to suit it very well. Such manure as is available is heaped in the dry weather and the land is cleared of deep-rooting grasses: on the first showers the land is plowed repeatedly by the simple Indian plows, and two or three weedings are needed and, if planted in rows, harrowings to keep the surface mulch of soil. There may be all stages from the most primitive to the most advanced dry-farming.

Sowing varies greatly according to conditions, from two to three seeds in a shallow hole, broadcasting against a basket, or drilling. The rate varies according to whether it is grown for grain or green fodder, as well as the kind of soil,

etc. Four to ten times as much seed is sown for green fodder, as then the stems are as close as in a field of wheat: when grown for grain the plants are thinned when 6-8 inches high, so that they are about a foot apart each way: 10-15 pounds per acre should be sufficient for a crop intended for grain and straw, 40-100 pounds when it is intended for green fodder. Sorghum is often sown as a mixed crop with legumes, and the most various mixtures are in vogue in India. To give an example: five crops are sometimes sown together: cucumbers will ripen in six weeks, cow peas in three months, Sorghum in four months, red grass (pigeon pea or *Cajanus indicus*) in seven months and, when the latter is reaped, the whole field will be covered by it and no trace left that any other crop has been grown. The time of sowing depends on the incidence of the rains, not heavy rains, but occasional showers: this is extremely important in dry tracts, and is forcibly expressed by another Tamil proverb, "if the time of sowing is missed cholam will not grow if it is sown on a dunghill."

The best method of reaping is to cut the field and lay the plants spread out on the ground for four days, then raise them in cocks for a month to allow the immature grains to harden; then thresh and heap the straw into great ricks. This straw will keep for the best part of a year and provides good fodder for cattle. If raised for green fodder it may be cut as required, the best food value being obtained when the flowers are beginning to set seed: or the whole may be cut and stacked in a rick, after a little wilting, the stalks being laid with the heads inwards.

The yield depends, of course, on conditions, and there may be from 100 to 500 to 1500 pounds of grain; if grown for fodder anything up to 25 tons may be harvested. It is a common practice to ratoon the crop for a time, as the stalks left will send out many shoots. But this requires some care and should not be attempted by novices. The young foliage if poorly grown develops a deadly poison, but this does not occur if there are rains or the soil is moist and the growth free. Such ratooned Sorghum forms excellent grazing for the cattle.

The crop has its own diseases and pests, which are far too numerous even to catalogue in detail. All insects, all birds, many beasts, together with fungi and even small parasitic flowering plants. In growing crops, aphids, mites, ear moths, stem and shoot borers, smuts, rusts, protozoa, moulds: also seeds germinating on the plant in wet weather, low-lying places and alkaline spots should be guarded against: as stored grain the usual grain pests will also be met with. There is no space to speak of the value of the grain as food, but it may be mentioned that both grain and flour keep well because of the comparatively little water and oil that they contain. Bread cannot be made from it, as it will not form loaves, but as cakes and porridge it is excellent, once the somewhat peculiar flavor is mastered.

II. THE LESSER MILLETS.

After the remarks on millets in general in the two preceding papers (I.S.J., 1920, pp. 493 and 613), and the somewhat full treatment of the great millet, Sorghum, as a type, it would entail a good deal of repetition to write at all fully about the smaller species which make up the class. In the following, the three

chief ones have been selected for a more complete study, and it may be assumed that the rest, gradually tailing off into wild grasses only used as food in times of famine, but often planted as fodder for cattle, may merely be recorded, although it is impossible to give such a list in detail. Taking the whole series, from the great millet to the wild grasses, there is a regular diminution in the amount of care that they require in cultivation, this being, of course, coupled with a like decrease in the value and quantity of the crop, both in grain and fodder obtained. There is thus a wide field for selection, according to the purpose held in view by planters inclined to give them a trial, and the character of the land to be planted with them. * * *

Bulrush Millet (*Pennisetum typhoideum*).

This plant stands in some sort half-way between Sorghum and the lesser millets. It resembles Sorghum in certain respects. It has erect solid stems of some thickness and reaches a height of five to six feet: at the base aerial roots are met with which act, as in Sorghum, as supports for the plant, for it must be remembered that all of the millets are shallow-rooted and the taller ones are liable to be overturned by sudden gusts of wind: bulrush millet furthermore favors the lightest of soils. Like Sorghum, it is proterogynous, the female flowers in each spike being receptive before the pollen is scattered: and thus this crop is wind-pollinated and is liable to injury by rain showers at the time of flowering, indeed more so than in Sorghum. Heavy rain showers are specially harmful to bulrush millet at all times, whether by drowning the young seedlings, turning the leaves yellow when in active growth, in the flowering season, or by causing the grains to sprout and spoil in the head at maturity. But it differs from Sorghum in the form of the ear, which, as a long, smooth cylinder, bears a close resemblance to that of the bulrush, after which it is usually named: it tillers much more freely, so that a number of ears are borne on the same stool, and the leaves are much narrower.

The plant is a typical catch crop, matures very quickly and requires considerably less manure, a lighter soil and less cultivation than Sorghum. It is widely distributed over eastern Asia and the African continent, from India to China and Japan, and from Tripoli, where as "Shessab" it is recommended as a valuable irrigated fodder crop, and Egypt, where it is grown for its grain, to the Transvaal, which has an excellent variety, excelling those of India in vigor, rapidity of growth, length of spike and size of grain. In India there are many varieties, differing in quality and quantity of straw to grain, character of grain, and the ease of clearing it from the husk, size of spike, etc., and in one part the ear is provided with long awns or bristles which protect it from the inroads of birds, the chief enemy of the crop. While the smaller birds perch on the ear and go through the hidden stores of grain methodically, the larger ones, such as the parrots, which sometimes descend in immense numbers on the fields, cut the ears right off and fly to some tree, where they pull out half the grain and waste the rest.

The straw is not usually liked by cattle, although it does not appear to be deficient in feeding value. The grain is nutritious and heating, so that it is said

to be a favorite in North India in the colder part of the year. In whole tracts it is the main cereal of consumption, and there are some 15,000,000 acres of it in India, where alone the returns are available. The seed rate varies from 3 to 10 pounds per acre according to the character of the soil, but when, as is often the case, it is sown as a mixed crop (for instance with ground nut, an excellent combination) a good deal less is required. The yield varies enormously according to conditions: an average crop will be 300 pounds to the acre, but as much as 1000 pounds may be obtained under favorable conditions as a dry-land crop and double that quantity when irrigated.

Italian Millet (*Setaria italica*).

This is a very graceful millet. * * * According to some authorities, it is the most important millet cultivated, but one doubts whether the dominating character of Sorghum has been realized by these. Cultivation of Setaria is known to be very ancient, as it is one of the sacred crops of the Chinese, recorded as planted with much ceremony by the Emperor and his courtiers nearly 3000 years B. C. It is impossible to assign a native country to so old a cultivated plant, but it has been found in the Swiss lake dwellings, showing that it had a wide distribution in prehistoric times. At present its greatest development appears to be in China, Japan and India, but it is world-wide in its distribution, being used chiefly as grain in the three countries mentioned above and more as a fodder in Europe, Canada, the United States and South Africa, where it is known as "Boer manna."

In Madras there are about 2,000,000 acres, and it is often planted in alternate rows with cotton and other non-cereal crops. The seed rate is given as 5 to 6 pounds per acre if irrigated, half of that quantity if on dry land and of course still less if grown as a mixed crop. The yield as a dry-land crop reaches 600 pounds of grain per acre, and if irrigated 1000 pounds, with 1000 to 2000 pounds of straw. There are, as in bulrush millet, many varieties, chiefly in the amount of branching and thickness of its rope-like, nodding ears and in the size and color of its grain. As in other millets it is eaten as unleavened cakes or porridge.

Ragi (*Eleusine coracana*).

This millet forms a class by itself, and has many characteristic wild relatives: it always strikes one as a wonder, therefore, that it has such valuable properties. As the Indian flora contains a number of these wild relatives it is usually considered to be indigenous to that country. It is a moderately tall, tufted grass, with the ear divided into a number of radiating branches, after the manner of a bird's foot. It is cultivated as a cereal over India and Japan and parts of Africa, but there is not much literature available on the subject. It is largely grown in India, in the south as an important irrigated crop, but elsewhere rainfed, both in the plains and on the hills at the onset of the monsoon. Its cultivation in South India is very carefully attended to, the seedlings being raised in special, well-treated nurseries and then transplanted to land constantly kept moist, in these respects resembling paddy. About 2 pounds of seed will plant up an acre of land: this may seem a very small quantity, but it is very pro-

ductive and the seeds are very small, there being 157,500 to the pound. The yield is 2000-3000 pounds per acre with up to 8000 pounds of straw. As a wet crop it is invariably planted pure, but on dry land it is often mixed with pulses, oilseeds and other crops. There are several varieties, two main groups being distinguished by having the radiating branches of the ear spread out or closed in, after the manner of the human hand: in the form figured the ear is open. It is a very hardy crop and will grow where scarcely any other can be planted: the wet land forms are noted as specially resistant to alkali and salt, and ragi is often grown as a first crop on reclaimed land before it becomes fit for paddy.

Harvesting is difficult because of its habit of branching high up and thus bearing ears of different ages; the sickle is used or the ears are merely taken off by hand, and there have to be several reapings. It is supposed to be the most prolific of the grain class, and a record has been made of a single seed which gave rise to 56 upright stalks with 8100 grains. About 25,000,000 hundredweights are computed to be consumed every year in India alone. The porridge made from it is not unpalatable, especially when mixed with coconut milk, as the writer can testify, having frequently used it as a welcome change from oatmeal in the hot weather. It is specially valued by all engaged in heavy manual toil and is the general regimen in jails, as it is a very strengthening food. On one occasion, when the writer's supply of American flour gave out far from the source of supply, he was compelled for a couple of weeks to feed on ragi porridge and cakes, and he noted that he was able to do the most surprising marches without excessive fatigue. Ragi straw, which is fed half green, is considered a very good fodder.

The following analyses of the grain and straw of millets, paddy, and wheat, which have been taken out of a useful little Madras publication, R. C. Wood, "Notebook of Agricultural Facts and Figures," may be of interest to readers. The writer is indebted to the same publication for most of the figures of seed rate and yields.

	Water	Proteid	Oil or Fat	Carbo-hydrate	Crude Fiber	Ash	Nutritive Ratio[1]
Grain:							
Sorghum....	10.71	9.71	3.69	72.38	1.54	2.05	1 : 8.3
Ragi........	11.29	9.44	4.93	60.13	6.56	7.65	1 : 7.5
Varagu[2]....	8.84	8.04	4.57	65.20	7.39	5.95	1 : 9.5
Kambu[3].....	8.77	9.52	5.33	73.52	0.78	2.08	1 : 9.0
Paddy......	12.55	6.35	2.14	65.29	7.84	5.83	1 : 11.0
Wheat......	13.33	9.74	1.76	70.18	2.10	2.98	1 : 7.7
Straw:							
Sorghum....	8.70	2.10	1.50	39.67	39.77	8.24	....
Ragi........	14.16	1.94	0.62	49.11	28.93	5.24	....
Varagu.....	8.71	1.97	2.51	47.92	28.84	10.05	1 : 26.8
Kambu.....	7.07	1.94	1.33	43.99	37.63	8.04	1 : 23.5
Paddy......	11.04	2.70	1.02	40.84	29.23	15.17	....
Wheat......	8.71	3.01	0.98	37.93	35.69	13.93	1 : 13.0

[1] Proportion of nitrogenous to non-nitrogenous constituents of the food.
[2] **Paspalum serobiculatum.**
[3] **Pennisetum typhoidum.**

[J. A. V.]

The Vitality of Cane Seed.*

The seed of the sugar cane is, to all intents and purposes, similar to that of wheat, barley, and many cultivated and wild members of the grass family. It is very small, but with a little care it may be readily obtained in the following manner: Cut the arrow as soon as the feathery florets begin to fly away in the breeze—a sign that the arrow is ripe—detach the branchlets, and crumple up the mass in the hand and place it in a linen bag. After about a week, carefully rub the mass between the fingers on to a large, clean piece of paper, when the small seeds can be easily made out, inside the transparent chaffy scales, as short dark lines about 1.5 mm. long and 0.5 mm. broad. The seed of each variety or individual arrow may be preserved in a small corked bottle and kept in a dry place. The vitality of cane seed is usually considered to be very low, but this is probably not the case, considering its minute size, if ordinary care is taken to protect it from drying up.

In order to test this vitality, the seed may be sown in earthenware pans, a convenient size of which is one foot across and three inches deep. These pans should be filled with a mixture of equal parts of river sand and powdered horse manure. The latter should be completely freed from grass seeds by watering and exposing in a thin layer. When the grasses have germinated and been duly removed, the manure may be dried again and stored for future use. It is not necessary to take the trouble to sow definite numbers of seeds in the pans: it is doubtful indeed whether, by separating them from their enclosing scales, they may not be injured or dried up. What we want to know is the length of time after collection that the seeds still retain their germinating capacity, and for this purpose it will suffice to sow equal parts by weight of the arrow mass, at intervals of a fortnight or month. But the arrows must be broken up into quite small tufts to remove the thicker stalks, and also well mixed, because the number of seeds in the upper and lower parts of the arrow differs considerably. Weigh out a definite quantity of the mixed mass and spread it evenly over the surface of the pan, then water it lightly from a fine rose-can, and the fluffy hairs will adhere to the soil and not be blown away with the breeze; afterwards, keep the pans in full sunshine and water in a similar manner twice daily.

The first germinations take place within three or four days of sowing, and the tiny plants are removed day by day as they appear, a record being kept of all such removals. The sowings should be continued at intervals until no more germinations take place. That the vitality of the seed is often considerable may be seen from the accompanying table, which gives the results of an experiment with monthly sowings made at the Cane-breeding Station at Coimbatore in 1914-15.[1]

* From The International Sugar Journal, Vol. XXII, No. 260, p. 435.

[1] C. A. Barber, Studies in Indian Sugar Canes, No. 2. Memoirs of the Department of Agriculture in India, Botanical Series, VIII, 3, 1916, p. 127.

Variety	Date of Collection	Germination Test	Feb. 1	Mar. 1	Apr. 1	June 1	July 1	Aug. 1
Madras No. 2....	Dec. 9, 1914	500	500	300	200	100	20	0
Madras No. 6....	Dec. 15, 1914	500	500	300	200	100	20	0
Saretha	Dec. 14, 1914	500	500	500	300	200	40	0
Java	Jan. 4, 1915	500	500	300	100	50	0	0
B 208	Jan. 5, 1915	500	500	300	less than 100	12	5	0
Striped Mauritius	Jan. 5, 1915	200	200	100	50	12	0	0

Equal quantities of pounded arrow were sown in the first five, a less quantity being available in Striped Mauritius.

The arrows were collected from December 9th to January 4th and tested for germination before the experimental sowings commenced. Sowings were then made on the first of each month, with the exception of May, until August, when, no germinations resulting, it was assumed that the seeds remaining had died. Some of the cane seed was capable of germination seven months after collection. Saretha and the two Madras seedlings showed most vitality and the thick tropical canes least, but even in the latter much of the seed retained its life for four months. From this it appears that it should be quite easy to send cane seed from one end of the world to the other without injury, probably best in the arrow itself.

[J. A. V.]

On One-Bud Planting.*

A worker has recently claimed that a greater mass of canes to the acre can be obtained by planting only one bud of each set and placing the set so that this bud faces upwards.[1] He goes a step further. He also asserts that, as the result of experiment, by removing all the lateral branches and allowing only the mother cane to grow, a much more uniform crop can be obtained of thick canes which all ripen together, an obvious advantage in harvesting. But we confess that we are not convinced as to the soundness of this practice in the field. Let alone the great amount of troublesome work in planting, the number of sets must be enormously increased if each one is only allowed to produce one cane. There may perhaps be something to be said for allowing only one bud to grow from each set, for by this means we should, theoretically, be able to obtain a set of plants unhampered in their growth by a struggle with near neighbors. Healthier plants will undoubtedly be produced. In planting single-bud sets a more careful scrutiny of the planted material will be necessary, and it is well known that many diseases are propagated in the fields by careless selection of the plant cut-

* From the International Sugar Journal, Vol. XXII, No. 260, p. 436.

[1] Kulkarni, M. L., Experiments in planting Sugar Cane Sets with Single Eye-buds, etc. Agricultural Journal of India, Special Science Congress Number, 1918.

tings. It has recently been demonstrated that, by planting only one seedling of paddy (the rice plant) in each hole, instead of the time-honored bunch of seedlings, a better outturn of rice is frequently obtained; but with the allied sugar cane we must reserve our opinion, as it is a matter which the practical planter must settle for himself. The subject has been introduced here, merely to indicate that, in the working of the fields, there is plenty of room for a study of the underground branching system of the cane plant, and that time-honored customs need not of necessity always be the best. There is any amount of scope here and elsewhere for the thoughtful planter to conduct simple experiments of this nature.

[J. A. V.]

SUGAR PRICES FOR THE MONTH

Ended March 15, 1921.

	96° Centrifugals		Beets	
	Per Lb.	Per Ton.	Per Lb.	Per Ton.
Feb. 16, 1921	5.77¢	$115.40		
" 18	5.64	112.80	No quotation.	
" 23	5.77	115.40		
" 28	5.765	115.30		
Mar. 3	5.77	115.40		
" 4	5.765	115.30		
" 7	5.825	116.50		
" 8	5.96	119.20		
" 9	6.01	120.20		
" 11	6.02	120.40		

[D. A. M.]